bart
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program

DATA NEEDS FOR MEASURING THE IMPACTS OF NEW TRANSPORTATION SYSTEMS: THE BART EXPERIENCE

The BART Impact Program is a comprehensive, policy-oriented study and evaluation of the impacts of the San Francisco Bay Area's new rapid transit system (BART).

The program is being conducted by the Metropolitan Transportation Commission, a nine-county regional agency established by state law in 1970.

The program is financed by the U. S. Department of Transportation, the U. S. Department of Housing and Urban Development, the National Science Foundation, and the California Department of Transportation. Management of the Federally-funded portion of the program is vested in the U. S. Department of Transportation.

The BART Impact Program covers the entire range of potential rapid transit impacts, including impacts on traffic flow, travel behavior, land use and urban development, the environment, the regional economy, social institutions and life styles, and public policy. The incidence of these impacts on population groups, local areas, and economic sectors will be measured and analyzed. The benefits of BART, and their distribution, will be weighed against the negative impacts and costs of the system in an objective evaluation of the contribution that the rapid transit investment makes toward meeting the needs and objectives of this metropolitan area and all of its people.

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BART IMPACT PROGRAM

DATA NEEDS FOR MEASURING THE IMPACTS OF NEW TRANSPORTATION SYSTEMS: THE BART EXPERIENCE

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NOTICE

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The early experience of the BART Impact Program suggests that this type of evaluation program might better concentrate on depth than breadth in its data collection and analytical activities. This recognizes the difficulties in studying impacts of small relative magnitude in an environment that is complex and dynamic. Research resources must be devoted foremost to the uncovering of the underlying causal mechanisms eliciting what we call "impacts". A misdirection toward the collection of a "comprehensive" data base is both wasteful of resources and is likely to force only superficial coverage of important issues.

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PREFACE

This report was prepared for presentation at the Thirteenth Annual Conference of the Urban and Regional Information Systems Association (URISA) in Seattle, Washington, on August 25, 1975. The viewpoints expressed here are exclusively those of the authors, and not necessarily the conclusions or policies of the BART Impact Program, its Federal sponsors, the Metropolitan Transportation Commission, or the Bay Area Rapid Transit District. We alone are responsible for this paper and its judgements.

DATA NEEDS FOR MEASURING THE IMPACTS OF NEW TRANSPORTATION SYSTEMS: THE BART EXPERIENCE

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August, 1975

Prepared for the 1975 Annual Conference of the
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DATA NEEDS FOR MEASURING THE IMPACTS OF NEW TRANSPORTATION SYSTEMS: THE BART EXPERIENCE

ABSTRACT The BART Impact Program is a comprehensive, policy-oriented study and evaluation of the impacts of the San Francisco Bay Area's new rapid transit system, BART. The Impact Program has just completed its initial phase of planning and investigation, and is now evaluating its results, research strategy and analytical methods developed thus far. The experience to date suggests that a more narrowly focused and concentrated effort may serve the ambitious research objectives better than an extreme devotion to comprehensiveness as its own end. This has broad implications for the further data requirements in the program. First, it suggests that we should seek a better balance between breadth and depth, with the scale tipped toward the latter. Second, it argues for the need to develop a workable set of typologies of populations and community settings so that the policy implications might be more readily transferable. Finally, this early experience points to a need to keep the phenomena of interest in clear focus in their regional context, accepting and accommodating to the inherent difficulties of measuring small relative magnitudes of change in a complex and dynamic environment.

INTRODUCTION

In evaluating alternatives for large-scale public investments, we often simply cannot win. We may be accused of looking at either too few alternatives or the wrong ones altogether. Even if the right alternatives are selected initially, there are endless wrong ways in which to evaluate them. The errors may be in the quality or quantity of data or in the misdirected applications of analytical techniques. When it comes down to the decision point, that old stand-by, professional judgement, may be the only way to resolve a dilemma which was caused in part by overfed data and undernourished analysis.

The evaluation of public transportation investments is most certainly subject to such predicaments. The traditional transportation planning process has begun with a determination of needs for travel, then has proceeded to (1) propose alternatives for serving that demand, (2) evaluate the alternatives in terms of cost-effectiveness or other criteria, (3) examine the financial feasibility of the alternatives, and (4) rank the alternatives for technical attractiveness. The alternatives then are tested for political feasibility by the public decision-makers or the voters. While this process and its actors have grown more sophisticated than ever over the years, there is still heard the complaint that the data were not quite what they should have been, or that the model the data were to feed was not operating properly.

Transportation planning has leaned heavily upon large-scale and data-hungry computerized models for mathematically representing and forecasting the relevant characteristics of alternative facilities and mixes. These models can be gross, aggregative approximations of reality, or theoretically elegant and behaviorally based representations of individual choice. Whether simple-minded or incomprehensible, they seem to have in common the application of brute force techniques to overpower both the intransigence of inadequate data and the intrinsic uncertainties of crystal ball gazing. The one clear advantage predictive models seem to have is the luxury of not being around when the projection year arrives. There are no warranties, expressed or implied, for the recommendations based on the outputs of these models, yet public investment decisions must be made regardless. With this basic mistrust of the traditional approach to promoting more informed decision-making, we must look elsewhere for counsel.

One obvious alternative to basing decisions on a predicted future is using instead a known past. The research and demonstration project or pilot study is quite common in fields like public health, education or criminal justice. At fairly low cost, with relatively small data requirements, such projects have been able to produce solid information for general application. This has usually not been the case in transportation, due in part to the sheer magnitude of resources required to produce a change large enough to achieve a desired effect. The built-in political and

financial penalties of sinking public funds into large and risky fixed facilities have provided a pragmatic disincentive to experiment with such options.

Unfortunately, it is just such large-scale transportation investment options which are now relevant in current policy decisions. With a clear down-trend in highway construction, the mass transit alternatives for urban areas are in vogue, and rail rapid transit often heads the list. Fortunately, there is a major "experiment" underway that may serve to assist in making the billion-dollar decisions now on the transportation horizon. It is the new San Francisco Bay Area Rapid Transit system (BART), the first regional rapid transit system to be built in this nation in over half a century. The BART Impact Program has been designed to capitalize on this opportunity by evaluating the full effects of this $1.6 billion investment. We hope that what we learn will be directly applicable to the needs of planners and decision-makers faced with evaluation of rapid rail alternatives. Having completed our first stage of investigation, we are presently examining our findings and methods, and testing our initial assumptions and expectations in order to refine our course through the final stage of the evaluation. The following reflections are based upon this early experience.

The BART Impact Program

The goal of the BART Impact Program is to assess the consequences of the decisions to plan, design, construct and operate the 71-mile regional rapid transit system. The evaluation is strongly oriented toward producing findings relevant to a broad range of current policy issues, while keeping a major emphasis on methodological precision. The measurement of the impacts of BART on the people of the Bay Area, its economy, environment and institutions, will provide valuable guidance to those urban areas presently constructing similar systems. This assessment will be particularly timely for the Federal government, which must make major resource allocation trade-offs among the many urban areas now contemplating some form of rapid transit system. Aside from the national importance, the evaluation will provide the Bay Area itself with a full accounting of its decision to expend over $1 billion of its local funds for BART.

Proposals for assessing BART's impacts date back to 1964, the year ground was first broken for BART's test track. A long-term study proposal was submitted to the U.S. Department of Transportation and the U.S. Department of Housing and Urban development in 1971, by a team of researchers at the University of California, Berkeley, with the support of the BART District and the Metropolitan Transportation Commission (MTC). MTC had been established by the California Legislature in 1970 to perform regional transportation planning and grant review functions for the nine-county Bay Area.

The two Federal departments entered into an agreement to jointly finance the collection of data on pre-BART conditions and the preparation of a detailed program design, contracting with MTC as their principal agent to conduct the impact assessment. MTC,

in turn, subcontracted with the University to proceed with the initial data collection, while taking upon itself the design of the multi-year program. These activities continued throughout 1972 and into 1973, when MTC submitted the program design to its sponsors. The basic structure and organization of the BART Impact Program were established at that time.

The majority of program activities are divided among six major impact areas, and a number of smaller, more specialized tasks. The six are:

1. Impacts on the transportation system and on travel behavior.

2. Impacts on the physical environment, and human responses to such impacts

3. Impacts on land use and the general pattern of urban development

4. Impacts on the regional economy and public finance

5. Impacts on cultural institutions and life styles

6. Impacts on public decision-making and policies

The specialized tasks presently include:

1. Development of an effective, user-oriented data management system for impact assessment data

2. Ground level photographic survey of areas immediately surrounding BART stations

3. Development of methods to assess the differential impacts upon population groups of special interest (the "transportation disadvantaged")

Each impact area and task is largely the responsibility of a contractor to MTC, or a consortium of contractors, with the over-all technical direction and integration of the work the responsibility of MTC.

Research and Analytical Strategy: The General Approach

The syndrome known as the tyranny of the present often militates against the careful and measured application of a well-conceived strategy. Such was the case in the earliest stage of the BART Impact Program. In early 1972, with the target date for the initiation of BART service looming on the horizon, we hurriedly began collecting critical data on the pre-BART condition. To be sure, each data collection activity was justified by some concept of impact evaluation, but there was then no time to develop a cohesive structure that encompassed all data needs, much less one that pointed out clearly how the data would ultimately be utilized

to assess impacts. We tended to rely on rather traditional data collection tools - traffic counts on freeways and major arterials, home interviews about travel behavior and attitudes, and trip diaries. Late in 1972, we adopted our initial program design, a statement of research policy which laid out some basic concepts about impact relationships. By identifying a pre-BART state, of course, we had already admitted our presumption that the initiation of BART service would indeed induce what we could call impacts.

Throughout 1973, as we continued some data collection, we began to refine our approach. The framework we established focused upon tracing the consequences of decisions about BART as they were reflected in specific BART attributes. For example, the decision to make BART a steel wheel/steel rail system resulted in, among other attributes, a given operational noise level. The attributes are then viewed as the potential agents of change, the causes of impacts. The goals of the impact assessment include both the identification of these attributes and their impacts, and an understanding of the underlying causal mechanisms which relate each attribute to its impacts. Only through an understanding of why the impacts occur, or occur in ways other than expected, can we hope to apply our findings to other settings.

The afore-mentioned set of six impact areas soon evolved, as much from administrative convenience as conceptual clarity. The six do, however, encompass the realm of impacts implicit in the research strategy. Each of the six is defined broadly, in line with our early penchant for comprehensiveness. Still, whenever a new issue was broached ("where are you studying the energy impacts?"), we had to scrutinize our definitions anew, and like completing a multiple choice test, we would place the newcomer in the impact category that came closest to being correct. These incremental expansions of the scope of study have been a continuing source of consternation. Our charge was to examine all significant impacts of BART. We could not declare before the fact that certain kinds of impacts were absolutely insignificant. We could only make educated guesses about where to look, and hope our net was cast widely enough. We accepted the possible inefficiencies of asking too many questions, rather than risk not asking enough.

Research and Analytical Strategy: Five Key Issues

It is still much too early in our program to write the definitive handbook on impact assessment. Our first phase included significant work in only two of the six impact areas - impacts on the environment and on the transportation system and travel behavior. Still, we have learned enough from these to highlight five issues which we would urge others to consider in any future impact assesments. While of a general nature, they each have direct bearing on the definition of data needs.

1. Define the expected impacts

   This is no trivial task. It requires some difficult thinking at a high level of abstraction to clearly

describe why any impacts should be expected at all. We must look for the impacts everyone expects (e.g., reduced peak period traffic congestion), while keeping an eye out to those indirect or secondary impacts that are more subtle (e.g., BART as a means for creating a sense of regional identity in widely separated communities). BART was intended to have certain effects, and we must determine whether it did, or why it did not, as well as recognize the unintended effects (e.g., severe problems of BART station parking lot overflow).

Once identified, we must be sure to look at an impact in enough detail to lead to the understanding of its causes. We may describe the impact along many dimensions, but the minimum set would include:

A. Magnitude - How much of a change was expected? How much was actually observed?

B. Incidence or Distribution - Where and on whom was the impact most significant? Is there a pattern of impacts that suggests any systematic bias in the distribution across people or places of BART's costs and benefits?

C. Time-scale - Is the impact detectable within the time frame of the evaluation? Is the impact temporary or permanent? Does the magnitude or incidence of the impact vary over time or is it constant?

2. Match the measurement instruments to the nature of the impacts and the intended analyses

The measurement instruments, whether traffic count machinery or home interview surveys, must pass a basic test - they must be able to measure with a precision well within the expected magnitude of impact. This simple-minded criterion is not that easy to meet. If our traffic counters have an inherent error of 5-10%, and we expect the 24-hour total traffic volume to be reduced by no more than 5% due to BART, then we must either increase the precision of the machinery, seek alternative instrumentation, or abandon the assessment of that hypothesized impact. If we wish to detect a difference in the reported attitudes toward public transit between BART users and non-users through a home interview, the sample size will be the primary determinant of our ability to make inferences from comparisons of the responses in a longitudinal (time series or before/after BART) survey. If we cannot commit sufficient resources to guarantee a general population sample large enough to include enough users and non-users to produce statistically significant findings, we again must come to terms with our objectives. Where our goals do not require a formal statistical analysis, a

less rigourous approach may suffice. This may be the only option in cases where there is no effective way of drawing a truly representative sample of persons. The impacts upon the physically disabled might fall in this category.

3. Beware of confounding variables

The combination of small expected magnitudes of impact, drawn out gradually over time (in contrast to sudden, dramatic, one-time events), conspires to complicate analysis. Even if our instruments are precise and our data absolutely accurate, our analyses must be capable of performing as well in the non-ideal world as in the abstract. The classical theoretical assumption of all other things being equal is so far from the truth that it must be discareded. In our example of the presumably direct impacts of BART on traffic congestion, we must simultaneously consider what other events and influences might also affect traffic congestion during our evaluation. The one overpowering influence is likely to be the dramatic change in gasoline prices, which we might presume to have put a significant kink in long-term traffic growth curves. Other influences are the continuing changes in the operations and facilities of the rest of the transportation system, independent of BART: relative costs to users of alternative modes, metering systems on freeways to improve operating speeds, car pooling incentives during peak periods, and reserved lanes for buses. While it is not practical to monitor all of these "exogenous variables" simultaneously, an acute awareness of their existence is an absolute must.

4. Beware of background noise

Confounding, exogenous variables may fool us into attributing an impact to BART when it is actually due to another, unrelated cause. We may equally fail to recognize an actual impact if it is lost in the background "noise" of independent changes in the important variables. This relates the measurement instrument, the expected magnitude of impact, and the changes in the exogenous variables, but adds the consideration of how and when the measurements are taken. Staying with the traffic congestion example, the analysis would have to thoroughly comprehend the hourly, daily, weekly and seasonal variations in traffic. If the daily fluctuation in peak period traffic were of the same magnitude as the expected BART-induced impact, we would have to be exceptionally prudent in our decisions on the timing of data collection and the minimum sample size.

5. Nurture complementary and partial techniques

Cast adrift in this hostile methodological sea, we might soon give up in frustration, but for a few tools left to help chart our course. Built upon so-called "quasi-experimental designs," these approaches accept the uncertainties of the situation, and try to compensate by attacking from several mutually supportive directions.

Where classical research designs are built upon well-defined test and control groups, we recongize no such luxury in the impact evaluation. It is difficult to defend a selection of any "non-BART" area as identical in all relevant ways to a "with-BART" area. We have already admitted that many factors other than BART might be operating which would mask or imitate BART impacts. We can construct, however, several approximations of test and control groups.

First is the comparision of areas or groups in the post-BART period which differ principally in their proximity to BART or in their socio-economic character. This seeks a higher level of sophistication than the simple, common, but un-controlled before/after type of comparison. The second control includes both pre- and post-BART comparisons of areas or groups. A third is the extension of the second, based on a longer time series of data than the pre-/post-BART. The fourth option is a longer time series than the pre-/post-BART comparison, but without reference to control groups or areas. This looks for more aggregate deviations from observed trends.

A rather different kind of comparison is between post-BART areas or groups and a hypothesized state of affairs we call the "No-BART Alternative," the transportation system we think most likely to have evolved had BART not been constructed. This recognizes that a different mix of transportation facilities would have developed in the Bay Area if the voters had rejected the BART bond issue in 1962. This comparison with a hypothetical scenario, though likely to be more general and aggregate in nature than the preceding techniques, may most clearly identify the true net effects of BART. It is similar to the modern economic concept of "opportunity costs" - the true cost of any use of resources includes the benefits foregone by not selecting the next best alternative use of the resources. (Yes, this concept usually takes a while to sink in.)

In combination, these techniques may reinforce one finding or cast doubt on another. No simple summation of impacts is likely from this process, but by avoiding placing all our research eggs in one basket, the probability of success is greatly strengthened.

Data Needs

In the ideal situation, the full consideration of research and anlytical questions described in the previous pages would precede and determine the needs for data. Indeed, we could make a case for placing more emphasis on the coherent perception of the questions, and somewhat less on the design of mechanisms for producing answers.

We alluded earlier to some drawbacks in the application of computerized travel and land use models to planning evaluations. We should be more clear in stating the significant differences between data needs for an impact assessment and requirements for input to conventional models.

Operational models have a built-in constraint that does not encumber impact evaluation. Due to limitations in computational ability or theoretical basis, only a limited number of variables may be considered in a typical model. Once specified, the calibration of these parameters essentially sets the assumed causal mechanism in advance. While models thus already internalize generalizations about relationships among variables, impact assessments seek to test these notions within a much more flexible and less rigorous framework of causation. If carefully executed, the impact assessment may be one of the only ways to reliably test the assumptions in the models and provide insights for improving them.

Where data for models are often aggregated into zones for ease of analysis, the impact assessment makes no initial assignment of convenient geographic boundaries for impacts. (While disaggregate models are not subject to this criticism, they are now still in early stages of development and application, and not yet in common use.) Almost by definition, impacts are specific to a particular combination of causes. Localized and individualistic in nature, their causes and similarities are to be discovered, rather than asserted in advance.

The study of land values around BART stations might be an example for the contrast between the two approaches. Depending upon how it was calibrated, the model might only require data on a time series of assessed valuation and sales data, and some measurement of relative accessibility of zones near BART stations compared to those farther away. The model's assumption in this simple example is that land value is a function of accessibility, period. The impact assessment would want to go beyond this to establish the context which makes each station area somewhat different. Two of the key data items would be an evaluation of

the supply and demand for developable land in the particular market environment of each station, and an investigation into the development policies of relevant institutions (zoning and general plans, business incentives, public attitudes toward concentrated urban development). No operational model at present can consider causation at this level of detail, nor should it. It is our contention that this fine grain of analysis is the special domain of the impact assessment.

Data Coordination

Even if the data needs had been determined at the outset of the impact evaluation in a structured and coherent manner, it is still very likely that the effort would have produced the same level of richness and diversity of data the Impact Program has accumulated to date. With this welter of data, we can make no pretense that it represents a single, unified and interrelated data base. Instead, it represents a selection of discrete and complementary items, most of which are highly focused and specific to the needs of a certain analytical scheme. This situation places a high premium on ensuring that some degree of coordination of data collection activities occurs wherever it can.

We need to distinguish between the coordination and the consolidation of data requirements. It should now be obvious that no single data collection effort could gather in one sweep all the kinds of data required for even one of the six major impact areas. We should not expect there to be many opportunities to actually consolidate diverse needs into a single activity. Coordination, on the other hand, may occur frequently and in many opportunistic ways. Since surveys of individuals are often the most costly technique we use and the most likely to produce undesirable conflicts and overlaps, it is coordination of these surveys which most concerns us.

Survey coordination may be based upon a geographic definition. For example, we have previously selected for detailed home interview surveys of travel behavior the areas which are served by four BART stations. The reasons for the selection of those areas are specific to the needs of one impact area. We have the option of concentrating other kinds of surveys in the same locations, if we believe there is an advantage in producing an assessment of the several kinds of impacts on those areas. This might be our preference if we sought to relate different impacts directly, for example, to draw some conclusions about the travel behavior impacts based upon perceptions of environmental impacts. The generally diffuse and varied nature of impacts suggests that it is unlikely that the most interesting or significant impacts would agree to cluster for our convenience.

Coordination may also be grounded in a common definition of the population of interest. If two impact areas needed interview data for the entire three-county BART District or service area, they could use the same proportional or random sample and either "piggyback" their different questions in the same survey, or use one survey to serve as a screen to select respondents for a later follow-up survey.

At present, all participants in the Impact Program have the opportunity to comment upon each other's proposed survey questionnaires, and suggest additions to serve their interests. Trade-offs among competing requests are made by MTC and are based upon consideration of critical data needs and resource limitations, as well as on the restrictions on time or length inherent in the particular survey method.

A less ambitious, but very useful means of coordination among the survey data collection efforts is ensuring that basic descriptive data are asked in an identical manner in all surveys, no matter what the specific impact content matter. These items include demographic characteristics of the respondents and their household settings, employment status, automobile availability, transit usage, and residential and job mobility. By adding a few key questions of interest to many areas, the opportunity is created for each impact analysis to seriously consider the data generated for another user. When the comparisons or pooling of data are thus facilitated, better utilization of the data resources is assured.

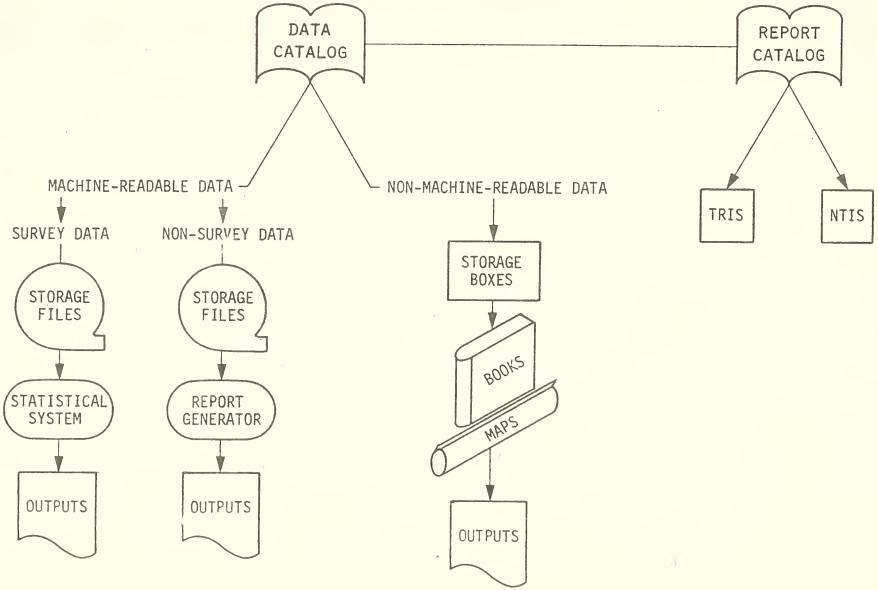
BART Impact Program Data Management System

The only way in which this mass of data would be effectively utilized would be to ease the usual pains of finding what we want when we need it, in a form that requires little or no conversion before use, and amenable to fast and efficient processing. These are the objectives of the data management system now under development. A simplified schematic of the system is presented in the following figure.

The overall unifying framework of this system is the data catalog. Not a data dictionary to describe each variable, this catalog functions at a more general level to describe all the sets of information that are available. These may be published reports, maps, machine-readable data sets, or documents which describe such data sets. The latter may consist of printed data dictionaries or survey codebooks.

Each reference in the catalog includes bibliographic information about the data set, including general subject key-words. Additionally, physical description and physical location information is provided. For those data sets that are not machine-readable, this information may point to a shelf or box storage. For machine-readable data, the physical description points to the retrieval system used to access the data set.

DATA SYSTEM OVERVIEW



A subset of the information in the data catalog is available to a much larger user community. This is the special catalog of the technical reports produced in the Impact Program. In addition to a published form, it is also available in an on-line bibliographic search system called TRIS (Transportation Research Information System), developed by the Transportation Systems Center of the U. S. Department of Transportation.

Because of the disparity in usage patterns between survey data and other types of data, a dual data access capability has evolved. This consists of a statistical file system specially designed for the efficient handling of survey data, and a more general file management and report generation system for all of the other machine-readable data. In both cases, a user-oriented system will be available for accessing the desired data. The report generator is the only element of the system not yet fully operational, and it is scheduled to come on-line by November, 1975.

The report generator will be capable of the standard features, plus an important set of not-so-standard ones. One of these is the capability of producing computer-readable files in addition to printed reports, including binary files for in-house use in external programs or systems; formatted files especially tailored for input into standard systems such as SPSS and SYMAP; and formatted files suitable for sending to users at other computer installations. Another feature is the printed job-log of each job done by the report generator: how much data was retrieved, what intermediate operations were performed, and what reports were produced. The report generator will make use of a data dictionary containing information about every variable and all record keys. Name codes, names for printing in reports, type and formatting of information are included in this dictionary, which is a separate sub-file from the data itself. This allows one dictionary to be used with several data sets, where appropriate.

All this may seem like an over-emphasis on data handling capabilities, but this, too, is related to the goals of the impact assessment. The data are not collected as massive one-time shopping excursions to obtain fodder for a model. The data are intended to be subjected to rigorous and continous analysis by a variety of researchers - sophisticated and simple, within the Impact Program or working independently.

Lessons Learned

The sincere desire of the BART Impact Program to take to its ambitious task in both a thorough and comprehensive manner bears some resemblance to the experience of BART itself. Recently, an article appeared on BART's problems in dealing with technological innovation, while promising a deluxe, workable system to the taxpayers. The author concluded that BART had been too naively optimistic and too caught up in its own euphoric publicity. We

might draw the analogy that the Impact Program has also promised a lavish product in the form of a comprehensive assessment of impacts, and too optimistically assumed that we could also simultaneously up-date and sharpen the traditional methods of data collection and analysis as we were applying them.

The collection of data received an early emphasis in the program, and sometimes appeared to have a life of its own, independently from the intended analyses the data were presumed to serve. Emphasis now must shift from gathering data - merely sets of numbers and symbols - to producing information - data summarized, tabulated or interpreted to address in a meaningful way the needs of a particular audience. The primary output of the impact assessment must be the more complete understanding of why and how the impact process works. To this end, it may be necessary to pursue fewer issues, but in more depth. An overemphasis on comprehensiveness may simply be an inefficient use of resources. The setting of clear research priorities then takes on more importance.

One way of setting priorities is by reference to the program's goals. If a primary goal remains the transferability of the findings to other urban areas, then we must be certain to pay attention to the common denominators that link the Bay Area and other urban areas. Where before we were pursuing region-wide or system-wide assessments, we might now prefer more narrowly focused evaluations. For example, a regional travel impact assessment would unavoidably and inextricably mix the unique characteristics of the Bay Area's development history, climate, topography and population characteristics so that BART-induced impacts might be terribly difficult to isolate. On the other hand, the study of a smaller, more homogeneous population (upper income suburbanites, or inner city minority groups, to pick two readily comprehended stereo-types) might be accomplished at a level of detail that could be useful in any urban setting. This argues for the development of a workable set of typologies of population groups and community settings for policy interpretation.

It is not difficult to lose oneself in the technical details of creating an elaborate microscope to peer into the innards of such a fascinating organism as BART. One runs the risk, however, of losing the wider perspective that would take in the larger environment which nourishes and constrains its actions. We will have to studiously avoid tunnel vision and blind oversimplifications about BART's impacts, without becoming lost in the inherent difficulties in ascertaining small relative magnitudes of change in a complex and dynamic setting.

With a well-founded respect for the complexity of our task, we may take heart from the recent announcements of the discovery of new subatomic particles. In that risky research, the very existence of the main objects of study could only be inferred indirectly by tracing the barely perceptible evidence of their second or third order effects. At least when we become discouraged in our research, we can go for a ride on BART and be reassured that our presumptions of the existence of impacts might not be entirely fanciful.

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The viewpoints expressed here are exclusively those of the authors, and not necessarily the conclusions or policies of the BART Impact Program, its Federal sponsors, the Metropolitan Transportation Commission, or the Bay Area Rapid Transit District. We alone are responsible for this paper and its judgements.